

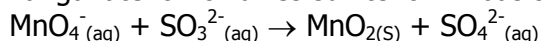
AP Chemistry: Electrochemistry

AP Chemistry Electrochemistry WS 0809.doc

Name: _____ Date: _____ Per: _____

1. Zinc metal reacts with nitric acid, HNO_3 , to produce a number of products, depending on how dilute the acid solution is. In a concentrated solution, zinc reduces nitrate ion to ammonium ion; zinc is oxidized to zinc ion, Zn^{2+} . Write the net ionic equation for this reaction.

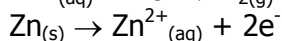
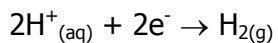
2. Permanganate ion oxidizes sulfite ion in basic solution according to the following equation:



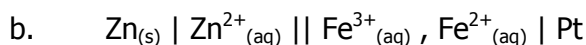
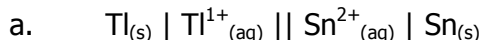
Use the half-reaction method to complete and balance this equation.

3. A voltaic cell is constructed from a half-cell in which a cadmium rod dips into a solution of cadmium nitrate, $\text{Cd}(\text{NO}_3)_2$, and another half-cell in which a silver rod dips into a solution of silver nitrate, AgNO_3 . The two half-cells are connected by a salt bridge. Silver ions are reduced during the operation of the voltaic cell. Draw a sketch of the cell. Label the anode and cathode, showing the corresponding half-reactions at these electrodes. Indicate the electron flow in the external circuit (with a lightbulb), the signs of the electrodes, and the direction of cation migration in the half-cells.

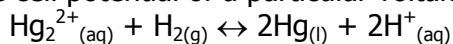
4. Write the condensed cell notation in which the electrode reactions are:



5. Write the cell reaction for the voltaic cells:

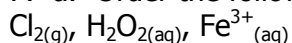


6. The cell potential of a particular voltaic cell with the cell reaction:

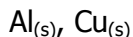


is 0.650V. Calculate the maximum electrical work of this cell when 0.500g of H_2 is consumed.

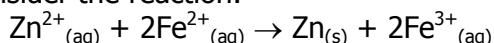
7. a. Order the following oxidizing agents by increasing strength under standard-state conditions:



b. Order the following reducing agents by increasing strength under standard-state conditions: $\text{H}_{2(\text{g})}$,

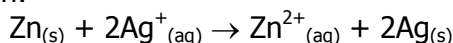


8. Consider the reaction:



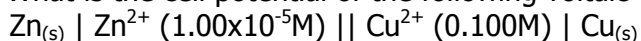
Does the reaction go spontaneously in the direction indicated, under standard conditions?

9. Using standard electrode potentials, calculate the standard free-energy change at 25.0°C for the reaction:



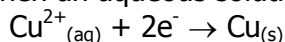
What happens to the free-energy if the coefficients of the reaction are doubled? What about the cell potential?

10. a. What is the cell potential of the following voltaic cell at 25.0°C?



b. What is the equilibrium constant, K_{eq} , for this reaction under standard conditions?

11. When an aqueous solution of copper(II)sulfate, CuSO_4 , is electrolyzed, copper metal is deposited:



(The other electrode gives oxygen: $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$). If a constant current is passed for 5.00h and 404mg of copper metal was deposited, what was the current?

12. Write a net ionic equation for the expected reaction when the electrolysis of $\text{NiSO}_{4(\text{aq})}$ is conducted using an inert platinum anode and a nickel cathode.